Edison as Generalist: A Clue to Creativity

INTRODUCTION

The College English Association has long stood for generalist rather than specialist training of liberally educated citizens in an increasingly industrialized society. Through articles in *The CEA Critic*, through conferences and institutes with business, through the life practice of many of its members, CEA has kept this belief before its constituency. This article about the generalist basis of the creative talent of Mr. Thomas Alva Edison brings special witness to our belief.

It is written by Mr. Edison's son, Theodore M. Edison, himself a brilliant example of the questing mind that passes easily over boundaries of specialization. For Ted, as he is known to his myriad friends, is an M.I.T. graduate engineer, inventor, and scientist who concerns himself creatively with city planning and conservation. Through his efforts large tracts of wilderness land have been preserved throughout the country. Nor does he stop there; over the years he has contributed to my own thinking about my specialty of language study. The editors are especially pleased to be able to bring to the readers of *The CEA Critic* this statement about the creativity of a distinguished American by his distinguished son.

—DAS

EDISON AS GENERALIST: A CLUE TO CREATIVITY[*]

One of the greatest factors in the success of Thomas Alva Edison was that he was a "generalist" in an extreme sense of the word. By this I mean that he had intense interest in almost all fields of human endeavor, and through a tremendous amount of reading and experimenting, he gained more than superficial knowledge of a great many of those fields. As a result, when he wanted to make an invention, he was able to draw ideas from a much broader base than is available to most specialists.

Today there seems to be wide acceptance of a belief that life has become so complex that no one can become expert in more than one or two narrow specialties, but an increasing minority is pointing out that our very lives may soon become endangered unless some way can be found to place generalist controls over specialists. A well engineered highway may ease traffic congestion, but it may also produce undesirable side effects—and if human factors are disregarded in selecting its route, it may add to the tensions that are leading to riots in our cities. Potent insecticides can produce spectacular results in controlling malaria and other diseases, but those same insecticides can quickly accumulate enough in our soil, air, and water to become serious pollution threats to our whole environment.

It may be thought that the ills of over-specialization can be easily overcome by making up teams of specialists drawn from different fields, but that method often fails because it is so hard to depart from entrenched modes of thought. Furthermore, technical language has become so specialized that specialists working in different fields can have great trouble in understanding each other. A sheet of music can conjure up complex harmonies in the mind of a trained musician, but musical notation is of no use in explaining musical ideas to anyone who has never learned to read music. There still seems to be need for combining substantial knowledge of different specialties in a single brain. I will use an example to illustrate my point.

Suppose that the movie screen in this room were to be observed by several people while it was being illuminated by a light that made the screen appear to be yellow. Then suppose that for some reason it should become important for the observers to testify about the color of the screen. Mr. A might say that he had seen a yellow screen, while Mr. B might say that he had seen a presumably white screen illuminated by yellow light. Mr. C, who had made his observations with scientific instruments, might show that the apparent color was produced by a mixture of green and red, and that there had actually been no yellow present. Mr. D could hold that it was foolish to talk about the color of the *screen*, because color doesn't exist until the radiation that produces the sensation of color reaches the eye of the observer. (If Mr. D's idea seems far-fetched, remember that a lot of color TV signals are passing through this room right now, and that in the absence of a suitable detector, we are not likely to connect the mere signals with any colors.) Even though the statements made by Messrs. A, B, C and D may appear to be in conflict, they can all be equally truthful and correct in the context of each man's ideas and observations.

It thus appears that the so-called "facts" in a case may run far deeper than the words used to report them, and much trouble can develop when a particular set of words calls up different pictures in different people's minds. I imagine that it would be very difficult for a committee made up of individuals with different types of partial color blindness to reach sound conclusions about the way the world looks to people with normal vision.

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[*] Originally presented as a talk before the M.I.T. Club of Northern New Jersey, January 24, 1969, at the Edison National Historic Site, West Orange, N. J.

A better way to get information on differences of outlook between people with normal vision and those with color blindness might be to find people who have normal vision in one eye and color blindness in the other—and believe it or not, there are such people! I think it is possible that one person of that kind could solve more color blindness problems through the blink of an eye than a committee could solve through weeks of work.

When Mr. Edison approached a problem, he frequently used a kind of "brainstorming" technique. He would write down all kinds of possibilities, and then progress through a more or less systematic weeding-out process. And economics played a very large role in his weeding out. In addition to getting a great many scientific journals, he also subscribed to a host of trade journals—and as part of his background knowledge he had a pretty good idea of the approximate costs and availability of a wide range of chemicals and common materials.

Mr. Edison had little knowledge of mathematics, but he had a "feel" for physics and found ingenious ways of solving problems without calculation. If he wanted to determine the volume of an electric light bulb he would probably not waste time with figures—he would simply fill the bulb with water, dump the water into a measuring graduate, and read off the result.

He used analogies extensively—and such use illustrates how ideas worked out in one field can be helpful in another.

As far as I know, the quadruplex, which permits four different telegraph messages to be sent over a single wire at the same time, is Mr. Edison's most "abstract" invention; and I believe he worked it out almost entirely on the basis of an analogy with a water system including pumps, pipes, valves, and water wheels. In view of all the messages that can be sent over a single wire today, Mr. Edison's quadruplex may seem quite commonplace, but I think that a modern circuit designer with wide knowledge of mathematical theory would still find it quite difficult to invent a practical quadruplex using only the simple relays and other pieces of telegraph equipment available to Mr. Edison.

When I used the word abstract, I did so because I think it is interesting to note that most of Mr. Edison's inventions are *not* abstract. He liked to work with physical pictures and analogies, and I think that if you will look at his inventions you will see that regardless of the ingenuity used in thinking them up, they can usually be explained quite directly with the aid of physical pictures.

He never liked alternating current, and for many years nothing but direct current was available at the laboratory. I have always felt that a good part of his objection to alternating current stemmed from the fact that he could not make a satisfactory physical picture of its action. However, there were plenty of fields open to his ingenuity that did not involve dealing with accelerations and other concepts that involve time in some complex way.

Prior to Mr. Edison's development of his electric light system, it was thought that 50% was the upper limit of efficiency for an electric generator because one approach to the design problem made it appear that maximum results could be obtained only when the internal resistance of the generator equalled the outside load resistance. When Mr. Edison said he had developed a generator with much higher efficiency than the theoretical limit, he was denounced for making absurd claims. Leading electrical authorities simply would not believe him because they held it was obvious that an efficiency higher than 50% was a mathematical impossibility. Once Mr. Edison's development is understood, it seems so simple that it is hard to see why the experts and electrical manufacturers of that day reached such strange conclusions. The trouble was that Mr. Edison's critics were just maximizing something that didn't interest Mr. Edison at all. To Mr. Edison, it seemed foolish to throw away great quantities of heat in the generator, so he (supported by his mathematical assistant, Mr. Francis R. Upton) simply reduced the loss there by lowering the generator's internal resistance—to disrupt the old 50%-efficiency-limit theory. I think this is a shining example of the way in which entrenched habits of thought can make specialists resist the introduction of radically new ideas.

For laboratory work, Mr. Edison often chose assistants who had little technical training because he said that experts knew too many ways in which things wouldn't work. On the other hand, he *did* employ experts, and he himself read what he could find on subjects under study. Mr. Edison has been called an empiricist, rather than a scientist, but I think that a lot of his "cut-and-try" procedures were far from unguided. In chemical research, he would set up all kinds of wild combinations in a search for clues, but I feel sure that the "wildness" itself was not achieved entirely by accident. He kept constant watch for anything that might look the least bit promising, and once a clue turned up, he would bunch experiments around it. . . .

In this talk, I have tried to show how Mr. Edison's generalist approach to problems helped him to make inventions. He pioneered in establishing organized research as a business, and through his knowledge of business and production, he was able to carry his inventions far beyond the laboratory stage. Many people who admire him as the "inventor of the electric light" fail to realize that the light he invented was only a small part of a great system that had to be developed. Switches, meters, generators, distribution systems, fuses, conduits, sockets, and a host of other items all had to be devised or perfected and coordinated for production, and when all was ready, politicians had to be persuaded to permit installation of power lines in city streets. Financial problems were also ever present, and a great deal of work had to be done in the face of opposition from those whose huge vested interests might be disturbed by the new inventions.

It is truly remarkable to see what can be done by a man who didn't even get through grade school!

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